many sands, contained within narrow fissures and capillaries and is not, for example, accessible to molecules as large as those of methylene blue. At the same time, certain parts of the external silica surface are removed in the process of dissolution of neighbouring basic compounds, leading to a 'smoothing out'. This latter assumption was supported by the discovery that the strongly acid extracts from the sands contained silica in solution in significant quantities.

It is hoped that this work, which forms part of a general investigation of the surface properties of sands of industrial importance, will be more fully reported elsewhere.

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Enrichment of Heavy Water by a Biological Method

In all methods for the enrichment of heavy water, the first stage is always very expensive, and a slightly enriched feed water could mean a lot in the price of the final product. Some biochemical processes, such as the photosynthesis of *Chlorella*[1], have been shown to give a small separation between light and heavy water. We have tried to investigate some further possibilities and measured the heavy-water content of water from some industrial biological and microbiological processes.

The greatest difficulty encountered in this type of problem is that industrial biological processes, for example, the growth of *Penicillum chrysogenum* in the production of penicillin, give a rather small volume reduction of the used water and can thus give only small enrichment factors. The most promising line of investigation seemed to us to be the first water percolation of barley in malt production, where the water uptake in the barley is a considerable fraction of the total water amount.

To ascertain the possibilities of the method, we have percolated barley with water in nine successive stages to get very great volume reductions. After every third percolation, the water was distilled to purify it from organic substances originating from the barley. Experiments were carried out with different proportions of barley and water, but otherwise under constant conditions as regards other relevant factors such as temperature, time of percolation, etc. The results are shown in Fig. 1 where enrichment factor α is shown as a function of the volume reduction ratio V_0/V. The diagram shows that there is a great difference in the enrichment proceeding in the various cases.

Lewis[2] has given the following relation for the separation factor s in the electrolysis of water:

$$\frac{dN_H}{N_H} = s\,\frac{dN_D}{N_D} \qquad (1)$$

where N is the total number of isotopic nuclei taking part in the separation process. By introducing the initial volume V_0 and the end volume V in equation (1) we get, after some approximations:

$$s = \frac{\ln V_0/V}{\ln \frac{V_0}{V} - \ln \alpha}$$

The enrichment factor α is here defined as the ratio between the molar concentrations of heavy water in the volumes V and V_0 respectively. The straight line that can be drawn in Fig. 1 for each series of successive percolations indicates that this formula can be applied also in our case. Stockholm tap water has been assumed to have a heavy-water content of 0·015 per cent w/w. The following values for s have been obtained:

Barley weight / Water weight	s
0·30	3·0
0·67	1·54
1·33	1·15

The isotope determinations have been made by means of infra-red spectrophotometry of the HDO absorption band[3] at 3·83μ. These measurements can be carried out with an accuracy of $\pm$ 0·003 per cent on the absolute D_2O percentage scale[4]. The observations of s were also confirmed by repeating a short series of three percolations with a water containing 0·5 per cent heavy water and analysing for isotopic contents by means of precision pycknometry.

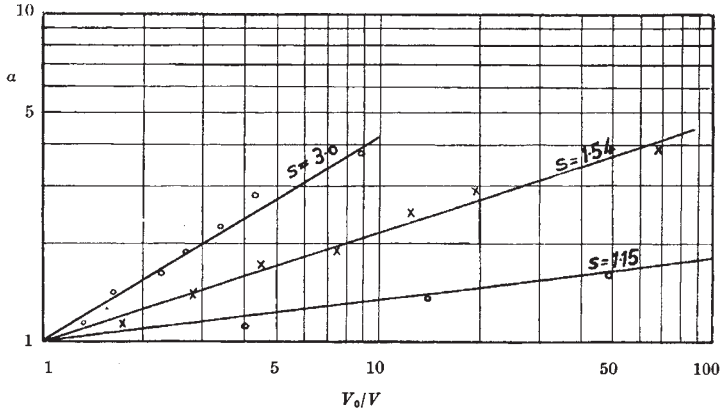

Fig. 1

The separation factors determined in this way seem surprisingly high for a biological method, and we cannot account for the variations in s with the barley–water ratio. One contributing factor may be the influence of the water contents in the barley.

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